

Preface

All of cellular life can be infected by viruses, and although many viruses are commensal, or even mutualistic, pathogens elicit a response in their hosts that involve various aspects of the host immune system. In humans and other animals, the innate immune system is often the first line of defense, followed by the adaptive immune system. Plants, insects, fungi, and even archaea and bacteria also invoke both innate and adaptive immunity in response to virus infections. The mechanisms of viral pathology in many cases are the result of this immune response being too strong. Immunopathology is well studied in human viruses. The importance of immunopathology also has been recognized more recently in plant-virus interactions. In this volume we cover a number of aspects of plant viral immunity that are involved in pathology in Chapters 1–4, before focusing on the viral immunopathology of vertebrates and insects in Chapters 5–10.

Chapter 1 provides a comparative review of the exploitation of small RNA-mediated defensive and regulatory systems by viroids and satellite RNA molecules in plants and by viruses in plant and insect cells. Chapter 3 takes up this narrative, discussing how viruses modulate symptom severity through their effects on small RNA pathways. The chapter also uses a range of specific examples to demonstrate how viruses and their gene products interfere with other plant immune systems and hormonal regulatory pathways to balance their need to replicate while preventing excess damage to the host. Small RNA-mediated RNA silencing systems were originally regarded as defenses against viruses, and indeed they may have originally arisen for this purpose. However, as these two chapters show, this primitive immune system has now become an exploitable target for viruses and sub-viral parasitic molecules to regulate their own replication and spread in the host.

Chapters 2 and 4 discuss the commandeering of host cellular components by viruses, and how viruses convert these to proviral factors that, instead of supporting normal metabolic or defensive processes, support viral infection and spread in susceptible plant hosts. Chapter 2 focuses on how plant viruses integrate plant defensive factors into protein complexes that facilitate viral infection and discusses the hijack of plant homeostatic processes by viruses, using specific examples. Chapter 4 describes how replication of tombusvirus-derived constructs in a yeast-based model

system is used to identify host gene products that support multiplication of positive sense RNA viruses. The review describes how protein chaperones, the ubiquitin-mediated protein degradation system, and cellular RNA helicases are co-opted for tombusvirus replication. Such studies have wider relevance for our understanding of positive sense RNA viruses not only of plants but also those of insect and vertebrate hosts.

Chapter 5 describes the current knowledge about bornaviruses and the role of T cell-based immunopathology that has been known for some time, and recent studies using animal models that are revealing many other aspects of the immune systems role in pathology.

In Chapter 6 we learn about the most recent findings of Zika virus immunopathology, as well as recent therapies and vaccine development.

Chapter 7 describes the immunopathology of influenza virus that has been studied for over 100 years, and how the virus and host must find a balance between clearing the virus and immunopathology.

Chapter 8 discusses what is known about the immune response to insect viruses and gives a perspective of areas of research that could address immunopathology in insects as models.

Chapter 9 covers the alphaviruses, including West Nile virus, the equine encephalitis viruses, and chikungunya, whose immunopathology can include long-lasting arthritic-like symptoms. Understanding the role of the immune system in these viruses is important for development of therapies.

In Chapter 10 we provide a discussion of the development of a vaccine for SARS-CoV-2 using reverse genetics, and the concerns of immunopathology in the use of vaccines for coronaviruses.

This volume brings together pathogenic viruses from very diverse hosts to demonstrate that the negative effects of viruses are often linked to the host response to the virus, rather than a direct effect of the virus on host cells.

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